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INSTALLATION RESTORATION PROGRAM

SITE 1 GROUNDWATER, SURFACE WATER, AND SEDIMENT

at the

ALLEGANY BALLISTICS LABORATORY, WEST VIRGINIA

PROPOSED PLAN

OCTOBER 1996

1.0 INTRODUCTION AND PURPOSE

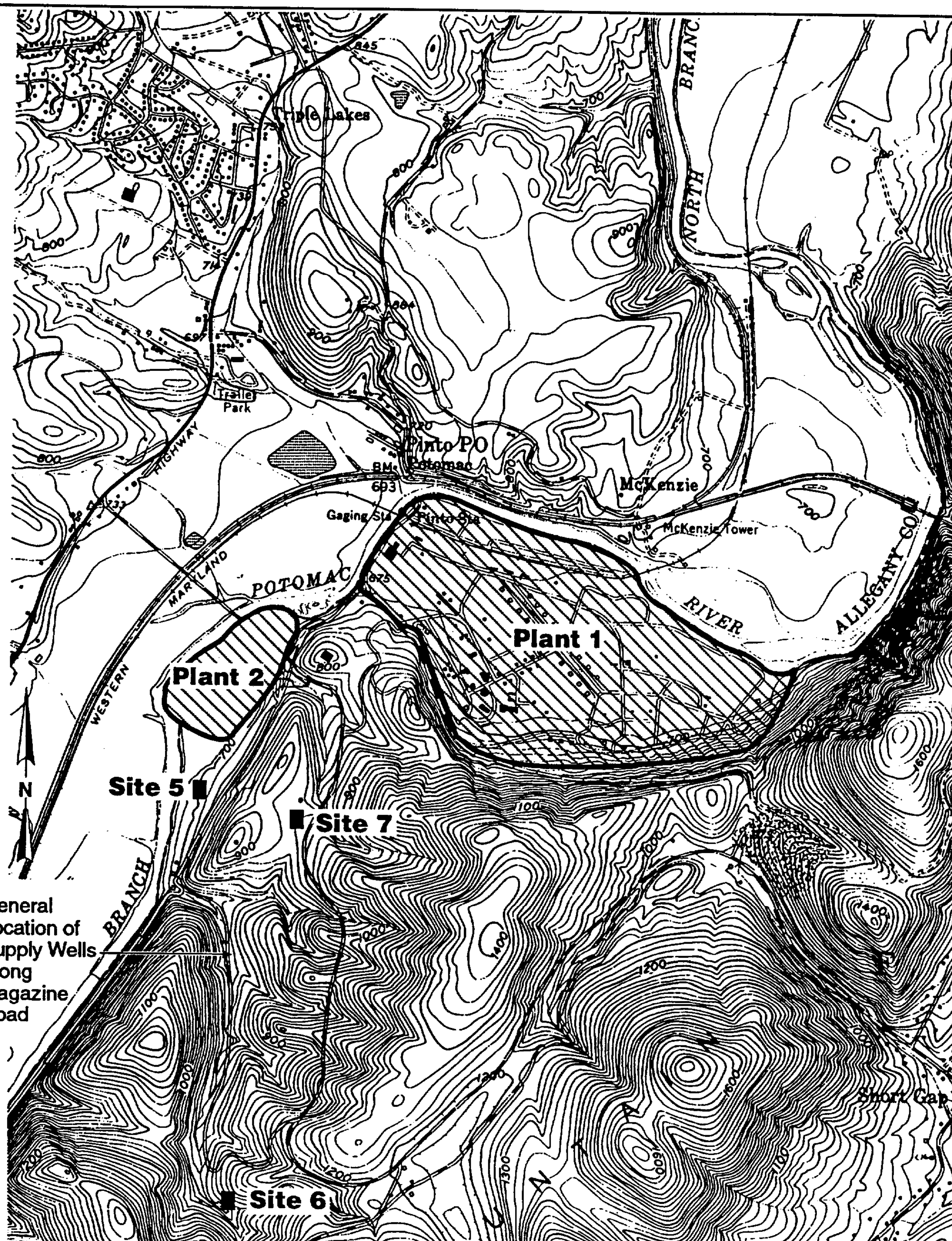
This Proposed Remedial Action Plan (PRAP) is issued to describe the Department of the Navy's (Navy) preferred remedial actions for Site 1 groundwater, surface water, and sediment at the Allegany Ballistics Laboratory (ABL), Rocket Center, West Virginia. The ABL facility consists of two plants (Plant 1 and Plant 2) and several additional sites (Figure 1). Site 1 is situated on the northern edge of Plant 1 and is bounded on its northern and western sides by the North Branch Potomac River (Figure 2).

The Navy is issuing this PRAP in fulfillment of the public participation responsibility established under Section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Navy, with the assistance of the United States Environmental Protection Agency (EPA) Region III, the West Virginia Division of Environmental Protection (WVDEP), and the Maryland Department of the Environment (MDE), will select a final remedy for Site 1 groundwater, surface water, and sediment after the public comment period has ended and the information submitted during this time has been reviewed and considered. The Final Decision Document may recommend different remedial actions than are presented in this plan, depending upon new information or public comments.

This PRAP presents a brief summary of information that can be found in greater detail in the *Remedial Investigation of the Allegany Ballistics Laboratory*, January, 1996, *Focused Remedial Investigation of Site 1*, August 1995 (Site 1 Focused RI), the *Site 1 Focused Feasibility Study for Groundwater*, June 1996 (Site 1 FFS), and other documents referenced in these reports. The Navy encourages the public to review these documents in order to gain a more comprehensive understanding of the site and the PRAP for groundwater, surface water, and sediment. The reports on which the decisions will be made are located in the following Information Repositories:

Fort Ashby Public Library
Box 74, Lincoln Street
Fort Ashby, West Virginia 26719
Contact: Jean Howser
304/298-4493

La Vale Public Library
815 National Highway
La Vale, Maryland 21502
Contact: Sondra Ritchie
301/729-0855



Source: USGS 7.5 minute Cresaptown, WV-MD quadrangle map.

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Scale in Feet

Figure 1
LOCATION MAP
Focused Remedial Investigation
Allegany Ballistics Laboratory

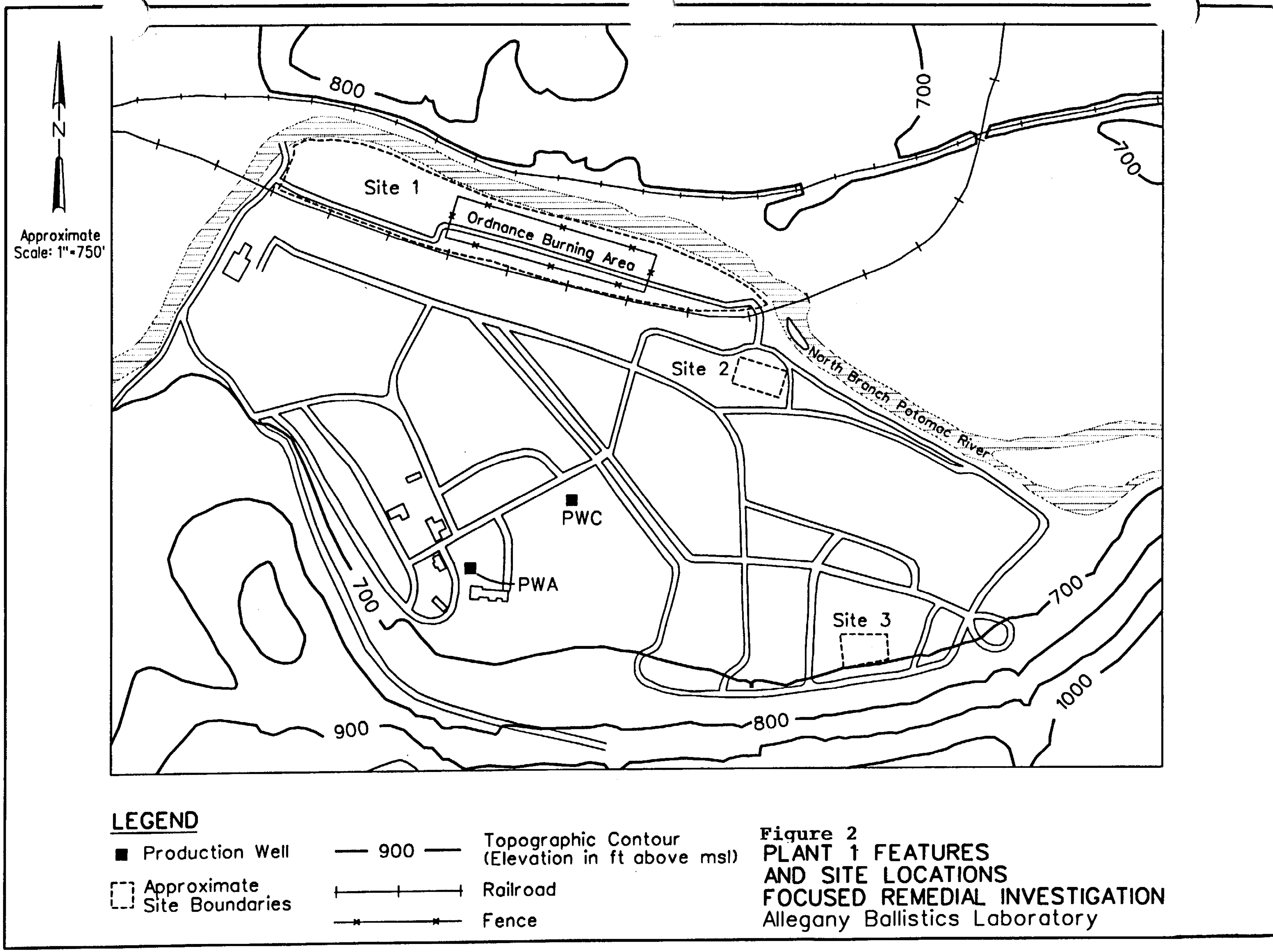

Figure 2
PLANT 1 FEATURES
AND SITE LOCATIONS
FOCUSED REMEDIAL INVESTIGATION
Allegany Ballistics Laboratory

The public is also invited to comment on this PRAP. The public comment period will begin on October 22 , 1996 and end on December 9 , 1996 for this Proposed Remedial Action Plan for ABL Site 1. A public meeting is scheduled for October 29, 1996 during the public comment period. The public meeting will be held at the Bel Air School.

Additional information on community participation in the decision-making process, including information regarding the public comment period, public meetings, information repositories, and a mailing list of Navy and/or agency contact people to whom public comments may be sent, is provided in Section 3.0 of this PRAP.

The remedial alternatives evaluated for remediation of Site 1 groundwater, surface water, and sediment are listed below, and the preferred alternative is noted thereafter. A more detailed description of these alternatives and an evaluation of each is presented in Sections 2.7 and 2.8 of this PRAP. The preferred alternative and the rationale for its selection is also presented in Section 2.9.

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

2.1.1 Site 1 Description

ABL consists of two plants and several additional sites (Figure 1). Plant 1 occupies approximately 1,572 acres and is owned by the Navy and operated by Alliant Techsystems. Plant 2, a 56-acre area adjacent to Plant 1, is owned exclusively by Alliant Techsystems. Plant 1 lies between the North Branch Potomac River to the north and west, and Knobly Mountain to the south and east. Several small towns and communities are located near Plant 1, including Pinto, Maryland,(1,500 feet to the northwest) and the community along McKenzie Road (750 feet north of the site) both located directly across the river from Site 1 (Figure 1). These Maryland communities include a total of approximately 30-40 residents who obtain all potable water from private residential wells (approximately 15 residents) or public water system. Short Gap, West Virginia, is located on the other side of Knobly Mountain, 5,000 feet to the southeast of Plant 1.

Site 1, shown in Figure 2, is approximately 11 acres and is situated on the northern edge of Plant 1. Site 1 is located on the alluvial plain above the North Branch of the Potomac River and has a range in elevation from 675 feet above mean sea level (msl) and 710 feet msl. A portion of Site 1 is located in the 100-year flood zone. Most of Site 1 is level, however there is lower topography and a man-made drainage in the western portion of the site. The northern edge of Site 1 is moderately steep, sloping toward a lower level terrace and the river.

The land use across the river from Site 1 is primarily agricultural. The land is used for growing corn and hay, and a dairy farm also exists at the eastern end of McKenzie road. In addition, an aeration basin treating wastewater from the unincorporated Maryland communities of Pinto, Bel Air, and Glen Oaks is located just west of Pinto and discharges to the river.

A limestone quarry and treatment works were formerly located to the northeast of the site across the North Branch of the Potomac River. The operation has been abandoned for over 50 years.

To the northwest of the site, a former industrial operation was located on top of the bedrock terrace.

There are no ground water production wells currently active on the alluvial plain portion of Plant 1 at ABL. Several residences utilize ground water wells, within 1,000 feet of the site across the river from Site 1. Springs have been identified on Plant 1 approximately 2,000 feet to the south of Site 1.

The North Branch Potomac River is the closest major surface body of water.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 History of Site Activities

Since 1959, Site 1 has been utilized for various types of waste burning and disposal activities. As shown in Figure 3, the site contains inert (non-ordnance), open, and ordnance burn areas, two landfills, a former drum storage area, and three solvent disposal pits. Within the fenced portion of Site 1, known as the ordnance burning ground, eight earthen pads were used to burn ordnance material generated at the facility. Near the southwest corner of the ordnance burning ground, three unlined pits historically were used to dispose of used solvents, acids, and bases generated by plant operations.

Near the eastern end of Site 1, inert wastes (i.e., rags, paper, etc.), possibly contaminated as a result of plant operations, historically were burned and the ash buried. Burning and disposal activities within this area have ceased.

Waste not classified as ordnance or explosive contaminated, such as sanitary waste, was burned in the open burn area, located near the western end of Site 1. The ash from the open burning activities was landfilled, together with building material and other nonflammable debris, in the open burn area landfill along the bank of the North Branch of the Potomac River.

Prior to 1981, the former drum storage area was used to store 55-gallon drums containing used solvents generated during plant operations. In August 1981, reports of deteriorated drums releasing their contents to the surrounding ground surface resulted in a cleanup effort in

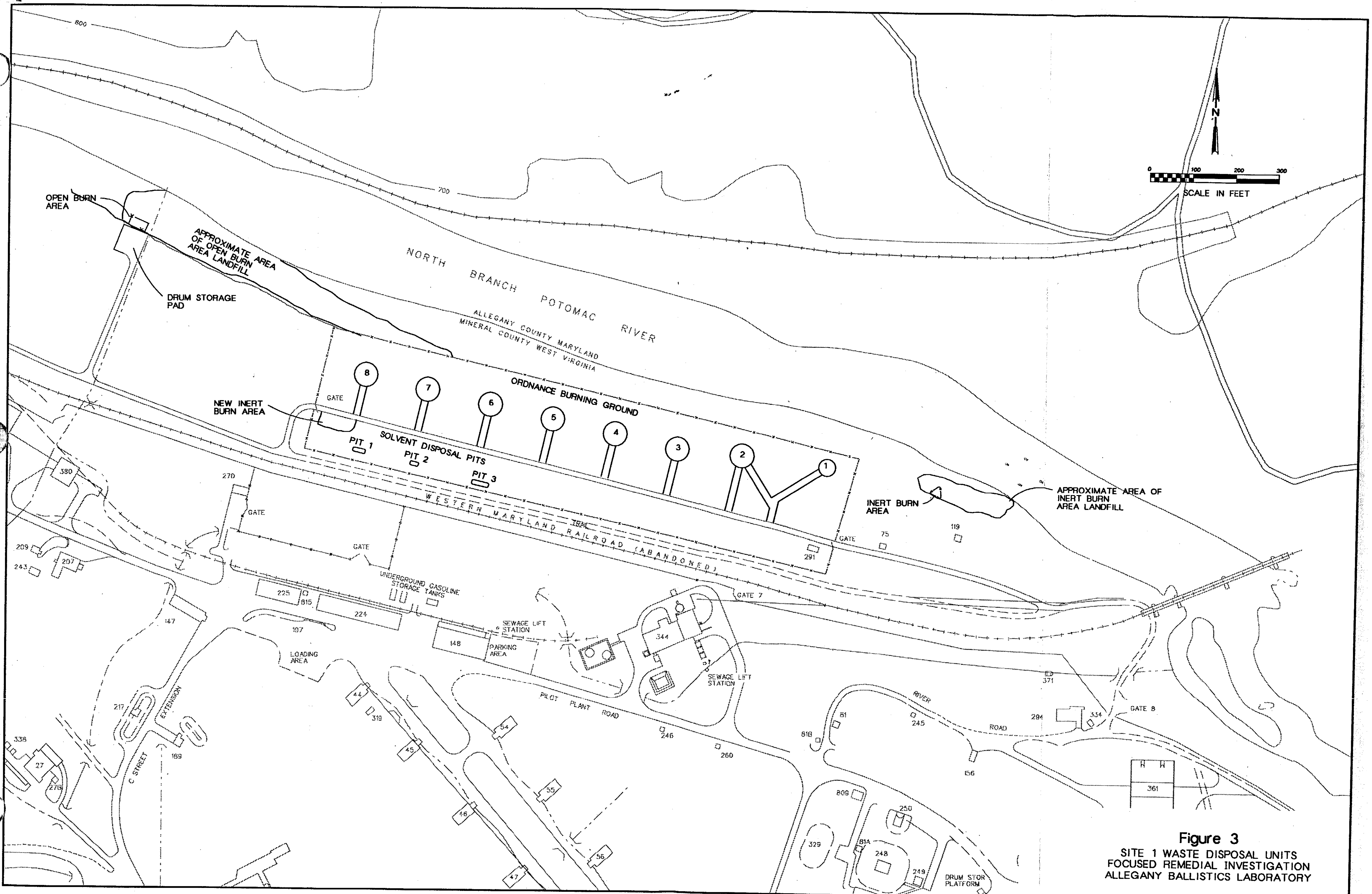

Figure 3
SITE 1 WASTE DISPOSAL UNITS
FOCUSED REMEDIAL INVESTIGATION
ALLEGANY BALLISTICS LABORATORY

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which the spilled material from the drums was removed from the ground surface and contained in new drums. The drums were then disposed in accordance with RCRA regulations.

2.2.2 Previous Investigations

Four investigations have been conducted at ABL during which Site 1 has been either part or the focus of the investigation: (1) the Initial Assessment Study (IAS); (2) the Confirmation Study (CS); (3) the Remedial Investigation (RI); 4) the Focused RI; and (5) the Focused Feasibility Study (FFS). The IAS, completed in 1983 under the Navy Assessment and Control of Installation Pollutants Program (NACIP), identified nine sites at ABL for further investigation (Environmental Science and Engineering, January 1983). The IAS concluded that these sites did not pose an immediate threat. However, the IAS showed the need for a confirmation study at seven of the nine sites, including Site 1, to assess the potential impacts on human health and the environment by suspected contaminants.

Following the recommendations of the IAS and in accordance with the NACIP, the CS was initiated in June 1984 and completed in August 1987. The CS focused on identifying the existence, concentration, and extent of contamination at the sites recommended for further investigation in the IAS. As a result of the Superfund Amendments and Reauthorization Act (SARA) of October 1986, the Navy changed its NACIP terminology and scope under the Installation Restoration Program (IRP) to follow the rules, regulations, guidelines, and criteria established by the EPA for the Superfund program. For this reason, the results of the CS are documented in the *Interim Remedial Investigation* (Interim RI) (Weston, October 1989). The Interim RI Report recommended further investigation at six of the seven sites, including Site 1.

Following the recommendations of the Interim RI Report and in accordance with the Navy's changed Installation Restoration Program (IRP) policy, Hercules Aerospace Company contracted CH2M HILL to conduct an RI following EPA's RI/FS format under CERCLA. The RI, initiated in May 1992 and completed in October 1992 (final document dated January 1996), was conducted to define the nature and extent of contamination at a number of ABL sites, including Site 1. The RI investigation at Site 1 is discussed in detail in the *Remedial Investigation of the Allegany Ballistics Laboratory*, January 1996 (RI).

In order to expedite the RI/FS process at Site 1 by filling data gaps remaining after completion of the RI, the Atlantic Division of the Navy contracted CH2M HILL to conduct a Focused RI at Site 1 following EPA's RI/FS format under CERCLA. The Site 1 Focused RI further defined the nature and extent of contamination at and adjacent to Site 1 and included baseline risk assessments for human health and the environment. The Site 1 Focused RI and the risk assessments are discussed in detail in the Site 1 Focused RI Report.

Based on the results from the previous four investigations a Focused Feasibility Study (FFS) was undertaken for Site 1. The FFS was conducted to assess several alternatives to address groundwater, surface water and sediment contamination identified at Site 1.

2.2.3 Enforcement Actions

In August, 1981, the State of West Virginia issued ABL a consent order for the improper storage of hazardous wastes at the storage facility within Site 1. ABL fully complied with all terms of the order resulting in no further action.

Consent Order (CO) #CO-R6,13,25-95-8 was issued on November 10, 1995 by the State of West Virginia. It deals with open burning of propellant and explosive (P/E) wastes and P/E contaminated wastes. The CO compliance program required cessation of open burning of P/E contaminated wastes by May 31, 1996. It also delineated three primary requirements: compliance demonstration; waste minimization and emissions mitigation; and utilization of an open burning management plan.

Compliance demonstration included construction of an incinerator if open burning of P/E contaminated wastes was not ceased, research on alternative technologies, determination of impact on human health and the environment, and relocation of the burn site if the impact were unacceptable. This order is currently in force and all order requirements are being met.

No other enforcement actions have occurred at Site 1.

2.3 SCOPE AND ROLE OF OPERABLE UNIT (OR RESPONSE ACTION)WITHIN SITE STRATEGY

The proposed response actions identified in this PRAP address contamination associated with Site 1 groundwater, surface-water, and sediment, as identified in the RI Report and the Focused RI Report. The recommended response actions (or preferred alternatives) for these media are identified and the rationale for their selection is described in Section 2.7.

The principal threats posed by conditions at Site 1 result from potential exposures to contaminated media, and from continued migration of contaminants from the soil to the groundwater, and from the groundwater to surface-water and sediment in the North Branch of the Potomac River.

As discussed in Section 1. of this PRAP, contamination associated with Site 1 soil will be addressed in a future FFS. This PRAP presents response actions to address contaminated groundwater, surface water, and sediment.

The proposed response actions for groundwater, surface-water, and sediment are expected to comply with the remedial action objectives (RAOs) identified in the FFS for these media which are:

> Prevent or minimize exposure of potential future onsite residents and construction workers to contaminated groundwater originating from Site 1.
>
> Prevent or minimize off-site migration of contamination originating from Site 1.

The proposed response actions are expected to comply with applicable or relevant and appropriate requirements (ARARs) and "to be considered" (TBC) requirements. ARARs and TBC requirements are federal and state environmental statutes that are either directly applicable or are considered in the development and evaluation of remedial alternatives at a particular site. Complete ARAR and TBC listings for Site 1 can be found in the FFS.

2.4 SUMMARY OF SITE CHARACTERISTICS

Site 1 is underlain by two distinct lithologies: (1) unconsolidated alluvial deposits of clay, silt, sand, and gravel; and (2) predominantly shale bedrock.

Unconsolidated

Drilling activities at Site 1 indicated that the unconsolidated deposits overlying bedrock generally consist of two distinct layers of material: (1) an upper, or surficial silty clay, considered floodplain deposits and (2) a deeper sand and gravel layer (alluvium), with variable but typically significant amounts of clay and silt. The floodplain deposits have an average depth of approximately 12 feet below ground surface (bgs) and the alluvial materials have an average thickness of approximately 14.5 feet beneath Site 1.

The sand and gravel alluvium constitutes the shallow aquifer at Site 1. The approximate position of the water table is based on water-level measurements collected in November 1994 during the Focused RI. The alluvial deposits are believed to be saturated through their entire thickness except near the river, where the water table drops below the top of the alluvium. Water-level measurements collected in November 1994 from all Site 1 alluvial wells indicate the direction of groundwater flow in the alluvial aquifer at Site 1 is toward the river. This translates into a north-northeast flow direction in the central and eastern portions of Site 1 and a northwest flow direction in the western portion of the site. As discussed previously, the average elevation of the river surface (648 feet msl) is within the 640 to 652 feet msl elevation range of the alluvial aquifer adjacent to the river at Site 1. This suggests that the river is the ultimate discharge zone for groundwater flowing laterally through the alluvium.

Hydraulic conductivities calculated from slug tests conducted in Site 1 alluvial monitoring wells and horizontal hydraulic gradients were used to approximate the average linear velocity of horizontal groundwater flow in the alluvial aquifer at Site 1. Assuming an effective alluvium porosity of 20 percent, the average linear velocity was estimated to be between 5 and 250 feet per year (ft/yr.), depending on the amount of clay in the alluvium and on the relative steepness of the hydraulic gradient.

Bedrock

Below the sand and gravel alluvium lies bedrock consisting of mainly calcareous shale and limestone of Silurian age. The average depth to bedrock at Site 1 is approximately 26.5 feet. Across the North Branch Potomac River from Site 1, no alluvium was encountered on the hill slopes and the top of the predominantly shale bedrock lies close to the ground surface.

During the RI and Focused RI, separate investigations were conducted to identify bedrock fracture sets and orientations in the vicinity of Plant 1 which may control local bedrock groundwater flow. During the RI, field measurement of 96 fracture planes identified two predominant orientations: (1) N26^{o}E; and (2) N39^{o}W.

The former measurement was the most common measurement recorded and is approximately parallel to the structural trend of the Wills Mountain anticlinorium and the Appalachian folds in the region. The latter orientation is oblique to the Appalachian structural trend.

During the Focused RI, aerial photographs were also studied and it was found that a number of probable fracture traces adjacent to the plant display orientations that are similar to the predominant fracture orientations measured during the RI. It is assumed that fracture traces displaying these predominant orientations also exist beneath Site 1.

Because of the limited bedrock-fracture data, the areal extent of fracture sets or voids at Site 1 is unclear. The bedrock coring data collected from two monitoring wells (1GW9 and 1GW15) at Site 1 suggest that there are no voids and that the fracture sets observed are limited in areal extent. Because the majority of the bedrock beneath Site 1 is believed to be shale, any voids or solution channels that have developed in the limestone near the west end of Site 1 are unlikely to have extended east through the site.

The pattern or direction of groundwater flow in the bedrock aquifer is similar to that of the alluvial aquifer, with both aquifers locally discharging to the North Branch Potomac River. However, unlike the alluvial aquifer, lateral groundwater flow in the bedrock aquifer is confined mainly to partings along bedding planes and fractures. Bedrock groundwater beneath the central and eastern portion of Site 1 generally flows northeast, approximately parallel to the strike of N30^{o}E, toward the North Branch of the Potomac River; groundwater beneath the western portion of the site is believed to flow in step-wise fashion northwest, approximately parallel to the strike of N39°W, toward the river.

Aquifer tests at Plant 1 and water-level data collected from the river and monitoring wells at Site 1 suggest varying degrees of hydraulic interconnection exist between the river and alluvium, the river and shallow bedrock, and the alluvium and shallow bedrock. In addition, water-level data collected from monitoring wells across the river from Site 1 suggest that bedrock groundwater from the western two thirds of the site clearly discharges to the river and does not flow beneath the river. These flow conditions are a result of the higher bedrock topography and related groundwater elevation heads that occur across the river in comparison to the bedrock on site. However, bedrock groundwater may migrate beneath the river from the eastern one third of the site. Water-level data from the bedrock wells on both sides of the river in this section of Site 1 are very similar, however the wells to the north have a slightly lower groundwater elevation head indicating potential flow in that direction. The wells across the river at this location have been sampled and no contaminants of concern detected at Site 1 were detected in these wells, so if groundwater does flow under the river Site 1 groundwater contamination has not reached that area. Similar to the alluvium, the river is most likely a discharge zone for shallow bedrock groundwater in the vicinity of Site 1.

Data collected from alluvial and shallow bedrock well pairs at Plant 1 indicate that the vertical component of hydraulic gradient is downward throughout the plant, including Site 1. This is not the case for the shallow and deep bedrock relationship in the north-central portion of Site 1. Here, the vertical component of hydraulic gradient was shown to be upward from the deep bedrock to the shallow bedrock.

Because the shallow bedrock was shown to be in hydraulic connection with the river, increases in head in the shallow bedrock resulting from recharge from the overlying alluvium can be dissipated through movement of shallow bedrock groundwater into the river. The deeper bedrock, likely recharged in the highlands to the southwest of the facility, may not be hydraulically connected to the river. Therefore, the heads at depth tend to increase in response to addition of groundwater in the recharge zone, which results in an upward vertical component of hydraulic gradient in the deep bedrock relative to shallow bedrock and alluvium along the river.

Sources of Contamination

Three former solvent disposal pits are located in the southwestern portion of the fenced area. These pits are considered the prime source of the ground water solvent contamination at Site 1. Two additional areas, identified as potential spill sites are possible sources for solvent contamination. These two area are located in the northeastern portion and the northwestern portion of the fenced area.

NATURE AND EXTENT OF CONTAMINATION

Based on site history, previous investigations and Site 1 Focused RI findings, contamination from prior land use practices at Site 1 has impacted surface soil, subsurface soil, sediment, surface water, and groundwater. A brief summary of the nature and extent of contamination follows. A complete list of the contaminants of concern detected in groundwater, surface water and sediment and their toxicological characteristics is presented in Appendix A. Due to site geology and the probability of dense, non-aqueous phase liquids (DNAPLs), an accurate estimate of the volume of contaminated groundwater plume cannot be made. However, Figure 4 provides an approximate areal extent of the contaminant plume. This summary focuses on the primary constituents associated with groundwater contamination, and is not intended to address all of the sampling, analytical, and evaluation results contained in previous investigative documents. A detailed discussion of contaminant nature and extent can be found in the Site 1 Focused RI Report.

Groundwater Contamination

During the course of the RI and Focused RI, groundwater samples were collected from all Site 1 monitoring wells and monitoring wells across the river from Site 1 for various analyses to determine the nature and extent of contamination. The analytical results are discussed in detail in the RI and the Focused RI, and are briefly summarized here.

Volatile Organic Compounds (VOCs)

Thirteen VOCs were detected in Site 1 groundwater during one or both investigations, but the six most prevalent (detected in six or more samples) VOCs were, in order of detection frequency: trichloroethene (TCE), total 1,2-dichloroethene

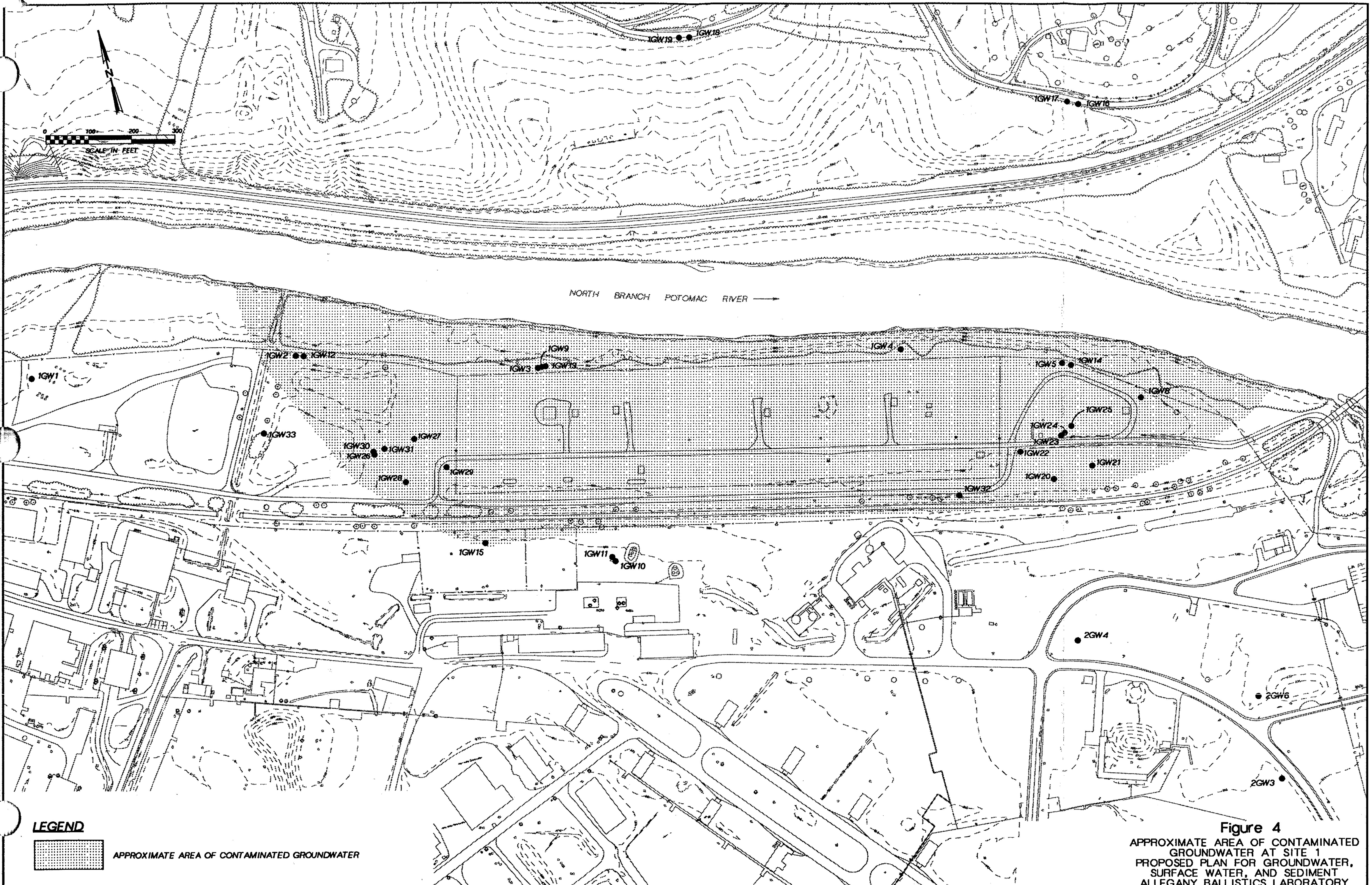

Figure 4
APPROXIMATE AREA OF CONTAMINATED GROUNDWATER AT SITE 1
PROPOSED PLAN FOR GROUNDWATER, SURFACE WATER, AND SEDIMENT
ALLEGANY BALLISTICS LABORATORY

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(1,2-DCE), methylene chloride (MC), acetone, 1,1,1-trichloroethane (1,1,1-TCA), and tetrachloroethene (PCE). Vinyl chloride (VC) was also detected, but in only one groundwater sample, at a concentration of 41 micrograms per kilogram (ug/kg). Of the VOCs detected in Site 1 groundwater, TCE was the most prevalent and was detected at the highest concentrations. The highest concentrations of TCE [(up to 240,000 micrograms per liter(ug/l)] were found in a well cluster located hydraulically downgradient of the solvent disposal pits. Concentration at this level indicates the presence of DNAPLs. TCE was found in all alluvial wells and most bedrock wells adjacent to the river at Site 1.

Similar to TCE, MC, 1,2-DCE, and 1,1,1-TCA were detected at the highest concentrations (8,000 ug/l, 4,800 ug/l, and 7,700 ug/l, respectively) in the well cluster located hydraulically downgradient of the solvent disposal pits. PCE was detected in both alluvial and bedrock monitoring wells at concentrations as high as 800 ug/l and 12 ug/l, respectively.

Inorganics

The highest total concentrations of inorganics in the alluvial aquifer on Site 1 were detected in a well considered to be an upgradient or "background" well for the alluvial aquifer at Site 1.

However, the total concentrations of 12 inorganics were found to be higher in one or more Site 1 bedrock wells than in a well considered to be an upgradient or "background" well for the bedrock aquifer at Site 1. The 12 inorganics include; aluminum, barium, iron, zinc, vanadium, cobalt, copper, nickel, arsenic, chromium, lead, and mercury.

Surface-Water and Sediment Contamination

Surface-water and sediment samples collected from the North Branch Potomac River upstream, downstream, and adjacent to Site 1 were analyzed for VOCs, SVOCs, and inorganics. Several of the surface-water and sediment sampling locations were located along areas with elevated levels of soil contamination detected in Site 1 soil.

The analytical results are discussed in detail in the RI and the Focused RI, and are briefly summarized here.

Surface-Water VOCs

TCE and 1,2-DCE (total) were the most prevalent VOCs detected in surface-water samples collected adjacent to and downstream of Site 1. MC was also detected, but at relatively low concentrations, suggesting that it may have been the result of laboratory contamination. None of the aforementioned VOCs were detected in the upstream surface-water sample, suggesting that groundwater discharging to the river from Site 1 is the source of VOCs.

Surface-Water Semivolatile Organic Compounds (SVOCs)

Bis(2-ethylhexyl)phthalate was the only SVOC detected, at an estimated concentration of 1 ug/l.

Surface-Water Inorganics

In general, inorganics concentrations in samples collected adjacent to and downstream of Site 1 were similar or lower than inorganics concentrations detected in the upstream sample.

Sediment VOCs

With the exception of acetone, which is believed to have been due to laboratory contamination, no VOCs were found in the upstream sample. The highest VOC concentrations were detected in the sediment samples collected adjacent to the groundwater well cluster hydraulically downgradient of the solvent disposal pits. In general, the VOC concentrations decrease in a downstream direction to non-detect within 1.5 miles of the eastern end of Site 1.

Sediment SVOCs

In general, similar SVOCs at similar concentrations were detected in sediment samples collected upstream, downstream, and adjacent to Site 1.

Sediment Inorganics

The inorganics data for the sediment samples collected during the RI and the Focused RI indicate that all inorganics concentrations were slightly higher in the upstream sediment sample than in the sediment samples collected adjacent to and downstream of Site 1.

Potential Routes of Contaminant Migration

Contaminated groundwater in the alluvial and bedrock aquifers at Site 1 is likely discharging to the North Branch Potomac River. Consequently, contamination (primarily VOCs) has been detected in surface water and sediment samples collected hydraulically downgradient from the approximate area of the contaminant plume at Site 1 (Figure 4). VOC-contaminated groundwater in the bedrock aquifer could possibly flow to the north beneath the river at the eastern end of Site 1 as discussed above, however, no VOC-contamination has been detected in monitoring wells or residential wells along McKenzie Road.

2.5 SUMMARY OF SITE RISKS

The human health and ecological risks associated with exposure to contaminated media at Site 1 were evaluated in the Focused RI Report. The human health baseline risk assessment evaluated and assessed the potential health risks which might result under current and potential future land use scenarios. Cancer risks are presented as a number indicating the potential for an increased chance of developing cancer if directly exposed to contaminants over an extended period of time. As an example, EPA's acceptable risk range for cancer is 1×10^{-6} to 1×10^{-4}, which means there might be one additional chance in one million (1×10^{-6}) to one additional chance in ten thousand (1×10^{-4}) that a person would develop cancer if exposed to the contaminants at the site using EPA's recommended exposure scenario. EPA's recommended exposure scenario for ingestion of contaminated groundwater for an adult resident assumes the individual consumes 1 liter/day for the first six years of their life and 2 liters/day for the following twenty-four years for 350 days/year. The risks evaluated for developing other health effects (using EPA's recommended exposure scenario)are expressed as a hazard index (HI). A hazard index of one or less indicates a very low potential to experience any adverse health effects based on EPA's recommended exposure scenario. An ecological evaluation was also performed and addressed the threats to ecological receptors. A summary of the human health and ecological risks associated with the site are summarized below.

2.5.1 Human Health Risks

Groundwater

There is no current exposure to contaminated groundwater because it is not used as a drinking water source at Site 1 or on Plant 1 at ABL. Future exposure to groundwater was evaluated for a future resident obtaining all of their potable water from the most contaminated groundwater at Site 1. Future adult resident exposure pathways include inhalation of VOCs while showering and ingestion of groundwater. Future child resident exposure pathways include dermal contact while bathing and ingestion of groundwater.

Groundwater risks for potential future exposure scenarios were calculated assuming two different water supply sources: the most likely residential water supply source, and a reasonable maximum residential water supply source. The definition of these sources is provided in the Focused RI Report, and the associated risks for each source is described below.

For the reasonable maximum exposure, which includes use of groundwater from the alluvial aquifer and shallow bedrock, the HI for the child resident is 4,000 and the HI for the adult resident is 3,000. TCE contributed greater than 90 percent of the total HI. The lifetime exposure age-adjusted cancer risk, which included dermal exposure while bathing up to age 7 and inhalation of VOCs while showering for 24 years, and ingestion of groundwater is 1×10^{-1}. The risk from ingestion is 5×10^{-2}, with TCE contributing 65 percent. The risk from inhalation of VOCs by an adult is 8×10^{-2}, mainly from vinyl chloride. The risk from dermal exposure to a child, 2×10^{-3}, is mainly caused by TCE.

For the most likely exposure, which includes use of groundwater from the shallow and deep bedrock, the HI for a child is 1,000, and the HI for an adult is 900. TCE contributed the majority of the hazard associated with inhalation, dermal contact, and ingestion. The lifetime exposure age-adjusted cancer risk, including dermal exposure while bathing for a child, inhalation of VOCs while showering for an adult, and ingestion of groundwater is 7×10^{-2}. The risk from ingestion of groundwater for a lifetime exposure (age 0 to 30) is 1 x 10^{-2}. The main contributor for the ingestion risk is TCE.

The risk from inhalation of VOCs by an adult is 5 x 10^{-2}. Vinyl chloride contributes approximately 83 percent of this risk. The risk to a child from dermal contact while bathing is 7 x 10^{-3}, with TCE contributing about 99 percent of the risk.

No human health risk assessment was performed for a future construction worker exposed to groundwater, however the risks would be much lower than the residential risk evaluated above.

Surface Water and Sediment

A quantitative human health risk evaluation of the surface water and sediment was not conducted during the base-line risk assessment. At the time of the evaluation, all of the contaminants in the surface water and sediment at Site 1 were eliminated during preliminary screening. However, after additional review considering human health risk from ingestion of fish several contaminants including iron, manganese, and antimony were determined to be of potential concern. Iron is an essential human nutrient.
The other two inorganic contaminants will be re-evaluated during the development of discharge limits and during monitoring of the effectiveness of the preferred action.

2.5.2 Environmental Evaluation

Analytical data compiled from the Focused RI were analyzed using EPA Region III guidance for determining environmental effects quotients (EEQs). Data was reviewed for surface water, sediment, and soil. EEQs were determined by comparison with standard guidelines. Ratios greater than 1 indicate a potential for risk, greater than 10 represent potential moderate adverse effects, and greater than 100 represent a significant potential for adverse effects. The exposure assessment for surface water, sediment, and soil is presented below.

Surface Water

EEQs greater than 1.0 occurred for mercury, silver, copper, chromium, and aluminum at a "background" sampling location. EEQs over 40 were reported for silver in several site samples. EEQs for aluminum, lead, zinc, and mercury also exceeded a value of 1 for sampling locations potentially receiving site-related contaminants.

Sediment

EEQs for two SVOCs exceeded 1 at a "background" sampling location, but were based on values for non-detects. Most of the site EEQ values exceeding 1 were the result of using non-detect values (i.e., one half of the detection limit). Based on the analysis of EEQ values for surface water and sediments, there are relatively few contaminants of concern (COCs). The COCs include: antimony, cadmium, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, TCE, and VC.

2.6 DESCRIPTION OF ALTERNATIVES

A detailed analysis of the possible remedial alternatives for Site 1 groundwater, surface water, and sediment is included in the Site 1 FFS report.

The detailed analysis was conducted in accordance with the EPA document entitled "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" and the National Oil Hazardous Substances Pollution Contingency Plan (NCP). A summary of the remedial alternatives which were developed to address contamination associated with Site 1 groundwater, surface water, and sediment is presented below.

GROUNDWATER ALTERNATIVE 1 - NO ACTION

Description: Under this alternative no further effort or resources would be expended at Site 1. Because contaminated media would be left at the site, a review of the site conditions would be required every 5 years. The review is specified in the NCP. Alternative 1 serves as the baseline against which the effectiveness of the other alternatives is judged.

Cost: There are no costs associated with this alternative.

Time to Implement: Implementation would be immediate.

GROUNDWATER ALTERNATIVE 2 - INSTITUTIONAL CONTROL ACTIONS

Description: The major components of this alternative include:

1. Locking up or abandoning existing wells onsite.

2. Legislation of a groundwater use restriction on the site.

3. Deed notations along with property use and limited access restrictions that would prevent residential development and access to the land overlying groundwater contamination.

4. Groundwater, surface water, and sediment monitoring on a routine basis, quarterly to semi-annually, for inclusion in the 5-year site reviews.

Cost: The estimated costs associated with this alternative are as follows:
Capital: $50,000
Annual operation and maintenance: $0
Net present worth (30-year): $50,000

Costs associated with performing the 5-year site reviews are not included.

Time to Implement: Three to four months to implement.

GROUNDWATER ALTERNATIVE 3 - SITEWIDE GROUNDWATER EXTRACTION AND AIR STRIPPING

Description: The major components of this alternative include:

1. Construction of a groundwater treatment plant onsite. The treatment plant will be located outside the limits of the 100-year floodplain. The preliminary major process components are flow equalization, metals precipitation and clarification, gravity filtration, air stripping, and off-gas treatment by thermal oxidation.

2. Extraction of groundwater across Site 1, treatment by the groundwater treatment plant, and discharge to the North Branch Potomac River.

3. During implementation of this alternative, an annual operation and maintenance (O&M) program will be established for the groundwater treatment plant. Deed notations and property use and access restrictions will be implemented to prevent future groundwater use.

4. Groundwater, surface water, and sediment monitoring on a timely basis, quarterly to semi-annually, for inclusion in the 5-year site reviews.

Groundwater extraction will occur across the length of Site 1 with the focus of preventing off-site migration of contaminants from the site to the river.

This will prevent the continued contamination of surface water and sediment in the North Branch Potomac River. Because the contaminant source (Site 1 groundwater) will be controlled, surface water and sediment will be remediated through natural attenuation (processes of volatilization, degradation,dilution, mixing, and sediment removal or erosion in the river).

Based on preliminary groundwater modeling, the extraction flow rate is estimated to range from 175 to 540 gpm, depending on the anisotropy exhibited by groundwater flow in the aquifer. The treatment plant flow rate will be revised based upon pump tests conducted on the extraction wells once they are installed and tested.

Discharge of treated water to the North Branch of the Potomac River will comply with ARARs, governed primarily by the State of West Virginia's National Pollutant Discharge Elimination System (NPDES) program. The Ambient Water Quality Criteria (AWQC) for water and organisms will be considered further in the calculation of final discharge limits to be protective of human health and the environment.

The State of Maryland has the right to review the discharge limitations imposed by West Virginia, and may impose more stringent limitations at their discretion. The treatment plant will be designed to comply with the final discharge limits once they are established.

Cost: The estimated costs associated with this alternative are listed below. Costs are given over the flow rate range of 175 gpm to 540 gpm.

Capital: $3,600,00 to $7,500,000
Annual operation and maintenance: $250,000 to $550,000

Net present worth (30-year): $7,400,000 to $16,000,000

Time to Implement: Six to twelve months to implement

GROUNDWATER ALTERNATIVE 4 - SITEWIDE GROUNDWATER EXTRACTION TARGET DNAPLs, AND AIR STRIPPING

Description: This sitewide alternative is very similar to Alternative 3. The major components of this alternative include:

1. Construction of a groundwater treatment plant onsite for treatment of flow in the range of 175 gpm to 540 gpm. The treatment plant in this alternative is identical to that specified in Alternative 3. Therefore, the treatment plant will be designed to comply with the final discharge limits once they are established.

2. Extraction of groundwater across Site 1 preventing flow of contaminated groundwater into the river allowing contaminated surface water and sediments to undergo natural attenuation. Extracted groundwater will be treated by the groundwater treatment plant and discharged to the North Branch Potomac River. A portion of the treated groundwater will be utilized by the facility, on an as needed basis, for steam generation.

3. Establishment of an O&M program for the groundwater treatment plant and extraction system. Deed notations and property use and access restrictions will be implemented to prevent future groundwater use.

4. A sediment, surface water, and aquifer monitoring plan will be undertaken as well to monitor contaminant concentrations in the river and across Site 1. Human health risk from ingestion of fish will be reconsidered during this monitoring. In concurrence with State and EPA, wells that no longer produce contaminated groundwater concentrations above MCLs would be shut off, providing residual groundwater contaminant concentrations do not present unacceptable risk to human and ecological receptors in the river. This process would continue until a smaller zone of

groundwater contamination is defined in the aquifer, likely corresponding to DNAPLs.

The extraction well network would be periodically evaluated and modified as necessary in order to enhance recovery of contaminants and better control the dissolution of DNAPLs into groundwater. As with Alternative 3, the treatment plant will be designed to comply with the final discharge limits once they are established.

Cost: The estimated costs associated with this alternative are listed below. Costs are given over the flow rate range of 175 gpm to 540 gpm.

Capital: $3,700,00 to $7,600,000
Annual operation and maintenance: $250,000 to $550,000
Net present worth (30-year): $7,500,000 to 16,100,000

Time to Implement: Six to twelve months to implement.

2.7 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives presented in Section 2.7 were evaluated in the FFS against nine criteria identified in the NCP. A summary of the evaluation criteria is presented as Appendix B.

2.7.1 THRESHOLD CRITERIA

Overall Protection of Human Health and the Environment

The Site 1 RAOs include:

Preventing or minimizing exposure of potential onsite residents and construction workers to contaminated groundwater originating from Site 1.

Preventing or minimizing migration of contamination from Site 1.

Alternative 1 does not achieve either RAO. Alternative 2 prevents exposure to contaminated groundwater through groundwater use restrictions, but off-site migration is not prevented and contaminated groundwater will continue to discharge to surface water and sediments. Alternatives 3 and 4 attain both RAOs.

However, because of the presence of DNAPLs, neither of these alternatives are expected to attain MCLs over the 30-year project life, however alternative 4 does have a containment plan for areas of groundwater that have DNAPLs.

Compliance with Applicable or Relevant and Appropriate Requirements

Groundwater chemical-specific ARARs (MCLs) would likely not be attained during the 30-year project life by any alternative. This is due to the probable existence of DNAPLs which may provide a continual source of contamination.

However, alternatives 3 and 4 are expected to achieve the MCLs in areas where DNAPLs do not exist. Alternative 4 will enhance contaminant removal by setting up containment of the area of groundwater contaminated with DNAPLs and better control the possible spread of dissolved DNAPLs. This will likely increase the volume of groundwater where MCLs are attained at Site 1.

All alternatives would comply with location-specific ARARs. Applicable ARARs focus on the presence of the 100-year floodplain of the North Branch Potomac River. All alternatives would comply with action-specific ARARs as well.

2.7.2 PRIMARY BALANCING CRITERIA

Long-term Effectiveness and Permanence

Alternatives 2 through 4 minimize the risk associated with groundwater contaminants remaining at Site 1. Alternative 2 provides the lowest degree of minimization by the use of deed and groundwater use restrictions. Alternative 2 does not prevent or minimize offsite migration of groundwater contaminants and consequently, surface water and sediment contamination would continue. Alternative 3 prevents offsite migration through groundwater extraction. Alternative 4 provides the most significant degree of risk minimization. The performance of the extraction well network in this alternative would be periodically evaluated and modified.

Wells that no longer produce contaminated groundwater concentrations above MCLs would be shut off, providing residual groundwater contaminant concentrations do not present unacceptable risk to human and ecological receptors in the river. Areas with sustained high concentrations of VOCs would be targeted enhancing contaminant removal, containment, and controlling dissolution of DNAPLs. Five year site reviews are required for each alternative.

Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment

Alternatives 3 and 4 provide reductions in groundwater toxicity, mobility, and volume. However, Alternative 4 enhances contaminant removal, establishes containment of the DNAPLs, and better controls the dissolution of DNAPLs into groundwater by targeting DNAPLs. These alternatives will prevent the discharge of contaminated groundwater to surface water and sediments, allowing contaminants in these media to undergo natural attenuation, effectively reducing the toxicity, mobility, and volume of contamination associated with surface water and sediments. Alternatives 1 and 2 provide no reduction in toxicity, mobility, or volume for groundwater, surface water, or sediments.

Short-Term Effectiveness

Alternatives 1 and 2 can be implemented the quickest, however they do not meet the remedial action objectives. Alternatives 3 and 4 can both be implemeted in about the same amount of time, six to twelve months.

The no action alternative and alternative 2 involve no construction or site activities, and would therefore produce no disturbance to the surrounding community and environment. Alternatives 3 and 4, which require well installation and the construction of a groundwater treatment plant and a significant piping network, produce minimal to moderate disturbance to the community. All construction will take place at Site 1 on ABL property. The majority of the risk results from fugitive dust emissions which can be controlled.

Implementability

Alternatives 1 and 2 require no technical innovation. Alternatives 3 and 4 require the design and construction of an effective extraction well network and the construction of a complex treatment facility. Groundwater extraction in fractured bedrock is complicated.

Aquifer testing will be necessary to evaluate whether a well network capable of attaining capture of the contaminant plume preventing groundwater discharge into the river is implementable.

There are many specialty vendors to provide expertise in sizing the treatment plant components. Jar testing is required to design the metals precipitation and pH adjustment process, and to select the optimum polymer dosage for flocculation of the inorganics in the groundwater treatment plant.

Cost

The annual operating and maintenance (O&M) cost is estimated to be the same for alternatives 3 through 4. On a present worth basis, Alternative 4 is slightly more costly, at $7,500,000 at a proposed flow rate of 175 gallons per minute(gpm) and $16,100,000 at a flow rate of 540 gpm. The present worth of Alternative 3 is $7,400,000 at a flow rate of 175 gpm and $16,000,000 at a flow rate of 540 gpm. Alternative 2 is the least expensive alternative (excluding the No Action Alternative), with a present worth of $50,000.

2.7.3 MODIFYING CRITERIA

State/EPA Acceptance

The West Virginia Division of Environmental Protection on behalf of the State of West Virginia, has reviewed the information available for this site and has concurred with this Proposed Plan. The EPA also concurs with the preferred alternative and with the information presented in this Proposed Plan.

Community Acceptance

The community will play an integral role in the selection of the final remedial alternative for cleaning up ground water contamination and controlling discharge to the surface waters at Site 1.

Community Acceptance will summarize the public's general response to the alternatives described in this Proposed Plan or the Feasibility Study. Comments and responses received during the forty-five day comment period and the Proposed Plan Public Meeting to be held on October 29, 1996 will be included in the Responsiveness Summary.

2.8 THE PREFERRED REMEDY

Alternative 4 - Sitewide Groundwater Extraction/Target DNAPLs, and Air Stripping, is the preferred remedial alternative. Based on available information and the current understanding of site conditions, Alternative 4 appears to provide the best balance with respect to the nine NCP evaluation criteria. In addition, the preferred alternative is anticipated to meet the following statutory requirements:

Protection of human health and the environment (groundwater, surface water, and sediment).

Compliance with ARARs. While compliance with chemical-specific ARARs (MCLs) for groundwater will not likely occur for the entire site during the 30-year project life, it is estimated that a major portion of the aquifer will be remediated to MCLs in 30 years, with the remainder of the aquifer to follow with continued groundwater extraction.

Cost-effectiveness.

Utilization of permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable.

The preferred alternative addresses all contaminated media at Site 1, except contamination associated with surface and subsurface soil overlying the groundwater aquifers. As discussed previously in this PRAP, a separate FFS will be prepared which addresses soil contamination.

2.8.1 PERFORMANANCE STANDARDS

The performance standards outlined below will be used to evaluate the overall performance of the selected remedy.

Attain capture of the Site 1 contaminant plume preventing discharge of contaminated groundwater into the North Branch Potomac River along Site 1.

Treat all extracted groundwater to levels meeting the substantive requirements of the National Pollutant Discharge Elimination System (NPDES). The Ambient Water Quality Criteria (AWQC) for water and organisms will be considered further in the calculation of final discharge limits to be protective of human health and the environment.

Groundwater extraction will be terminated after groundwater contaminant levels at Site 1 are below the Maximum

Contaminant Levels (MCLs) as defined in the Safe Drinking Water Act, providing residual groundwater contaminant concentrations do not present unacceptable risk to human and ecological receptors in the river. The target level for total noncancer risk, is represented by the hazard index (HI) of not more than 1 and for a total cancer risk within the range of 1×10^{-6} to 1×10^{-4}.

2.9 STATUTORY DETERMINATIONS

Remedial actions must meet the statutory requirements of Section 121 of CERCLA as discussed below. Remedial actions undertaken at NPL sites must achieve adequate protection of human health and the environment, comply with applicable or relevant and appropriate requirements of both Federal and State laws and regulations, be cost effective, and utilize, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. Also, remedial alternatives that reduce the volume, toxicity, and/or mobility of hazardous waste as the principal element are preferred. The following discussion summarizes the statutory requirements that are met by this preferred alternative.

2.9.1 Protection of Human Health and the Environment

The preferred remedial action will protect human health and the environment. The installation of extraction wells and the construction of a groundwater treatment plant will prevent continued discharge of contaminated groundwater to the river and will reduce contaminant concentrations in the aquifer.

However, due to the presence of DNAPLs, contaminant concentrations may not attain MCLs across the entire site in a reasonable time frame. Natural attenuation will reduce contaminant concentrations in the river and will eliminate the associated risk of exposure to human health and the environment.

Deed notations and property use and site access restrictions will prevent future use of groundwater, therefore eliminating direct contact, ingestion and inhalation threats associated with groundwater contamination at the site.

2.9.2 Compliance with ARARs

The preferred remedy will be constructed to meet all applicable or relevant and appropriate requirements (ARARs) whether chemical, action, or location specific. No waivers of any ARARs are requested.

Chemical-Specific ARARs - Attainment of ARARs for groundwater is accomplished through the use of extraction wells across Site 1 and treatment of extracted groundwater. In order to comply with chemical-specific ARARs, aquifer contaminant concentrations must be reduced to MCLs. This goal is complicated by the possible presence of DNAPLs providing a long-term source of continuing contamination.

This alternative will focus on controlling the DNAPLs and, because of their presence, attaining MCLs for all of the site is unlikely.

Under this alternative, extracted groundwater will be treated and discharged to the North Branch of the Potomac River. Chemical-specific ARARs require contaminant concentrations in discharged groundwater to be less than discharge limits established by the State of West Virginia and the federal government. The groundwater treatment system will be designed to meet these criteria.

Location-Specific ARARs - Site 1 is partially located within the 100-year floodplain of the river. According to 40 CFR 264.18(b), any facilities constructed in the floodplain of a river must be designed and constructed to avoid washout.

The groundwater treatment plant will be located an appropriate distance from the river, and outside the limits of the floodplain so that washout would not occur. Discharge piping would be located in the floodplain, and therefore, would incorporate concrete collars at intervals to counteract buoyant forces acting on the pipe during flooding.

The Navy performed an ecological risk assessment as part of the Focused RI. A site survey was performed, and information was gathered concerning the presence of endangered or threatened species on Site 1. Correspondence with federal regulatory agencies indicated that, except for the occasional transient individuals, no federally listed or proposed endangered species are known to exist on Site 1. Therefore, the requirements of the Endangered Species Act of 1973 (16 USC 1536(a)) will likely not be applicable to remediation activities occurring on Site 1.

The Wild and Scenic Rivers Act (16USC 1271 et seq. and Section 7(a)) requires the avoidance of taking action that will have a direct adverse effect on a scenic river. Because construction activities along the river bank may impact river water quality, this ARAR is potentially applicable. Erosion and sediment controls will be incorporated into the remedial design in order to comply with this ARAR.

Action-Specific ARARs - The State of West Virginia Groundwater Protection Act regulations (47CSR58-4.7 to 4.7.4) require that pipelines which convey contaminants should preferentially be installed above ground.

All residuals from the treatment of groundwater will be properly handled, characterized, and undergo proper disposal following federal and state regulations such as the Resource Conservation and Recovery Act (RCRA).

Post-closure use of the property would be restricted during the 30-year project life because the aquifers will most likely remain contaminated. Section 121(c) of CERCLA, as amended by SARA, requires a periodic review of remedial actions at least every five years for as long as contaminants which pose a threat to human health and the environment remain onsite.

2.9.3 Cost-Effectiveness

The preferred remedy is the most cost effective alternative in meeting the RAOs. The "no action" and "institutional control" alternatives are less costly than the preferred alternative, however these alternatives do not meet all of the RAOs. Although Alternatives 3 and 4 are approximately the same cost, the preferred remedy, Alternative 4, provides for better control of DNAPLs.

2.9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable ("M.E.P.")

The preferred remedy will greatly reduce contamination in surface water and sediment, and dissolved contamination in the groundwater providing a permanent solution in these contaminated areas. In addition, the groundwater extraction system will be modified as necessary to contain DNAPLs. Finally, a portion of the treated groundwater will be utilized by the facility for plant operations.

2.9.5 Preference for Treatment as a Principal Element

The preferred remedial action utilizes permanent treatment technologies to the maximum extent practicable for this operable unit.

3.0 OPPORTUNITIES FOR COMMUNITY INVOLVEMENT

A critical part of the selection of a remedial action alternative is community involvement. The Navy, EPA, and WVDEP are soliciting input from the community on all of the alternatives that have been proposed for this site.

Based on new information or public comments, the Navy and EPA, in consultation with the State of West Virginia and Maryland, may later modify the preferred alternative or select another remedial action presented in this Proposed Plan and the RI/FS. The following information is provided in order to obtain input from the community relating to the selection of the preferred alternative for Site 1 groundwater, surface water, and sediment.

The public comment period will begin on October 22 , 1996 and end on December 9 , 1996 for this Proposed Remedial Action Plan for ABL Site 1. A public meeting is scheduled for October 29, 1996 during the public comment period. The public meeting will be held at the Bel Air Elementary School.

Comments will be summarized and responses provided in the Responsiveness Summary Section of the Record of Decision. The Record of Decision is the document that represents the remedy selected for cleanup. To send written comments concerning this PRAP or to obtain additional information, please contact the following representatives:

Commander
Atlantic Division
Naval Facilities Engineering Command
Attn: Mr. Jeff Kidwell
Code 1823
1510 Gilbert Street
Norfolk, Virginia 23511-2699
804/322-4795

USEPA Region III
Hazardous Waste Management Division
Federal Facilities Section
Attn: Mr. Bruce Beach
841 Chestnut Building
Philadelphia, Pennsylvania 19107
215/566-3364

West Virginia Department of Commerce,
Labor & Environmental Protection
Division of Environmental Protection
Attn: Mr. Thomas Bass
1356 Hansford Street
Charleston, West Virginia 25301-1401
304/558-2745

Maryland Department of the Environment
Waste Management Administration
Attn: Ms. Wendy Noe
2500 Broening Highway
Baltimore, Maryland 21224
410/631-3440

Written comments must be postmarked no later than the last day of the public comment period, which is December 9 , 1996.
Additional information concerning Site 1 Groundwater and the reports on which the decisions will be made are located in the following Information Repositories:

Fort Ashby Public Library
Box 74, Lincoln Street
Fort Ashby, West Virginia 26719
Contact: Jean Howser
304/298-4493

La Vale Public Library
815 National Highway
La Vale, Maryland 21502
Contact: Sondra Ritchie
301/729-0855

APPENDIX A

TOXICOLOGICAL PROFILES FOR COCs AT SITE 1

VOLATILE ORGANIC COMPOUNDS (VOCs)

CHLOROFORM

Chloroform has a molecular weight of 119.38, and exists at room temperature as a clear, colorless liquid with a boiling point of 61.7 C. It is widely used in industry as a solvent, feedstock, and sterilizing agent, and is found in all chlorinated public water supplies (because it is a by-product of the chlorination process). Chloroform is soluble in water, acetone, and non-polar solvents, and volatizles readily from solution. It is readily taken into the body by inhalation, ingestion, and dermal or eye contact.

Chloroform is a Class B2 carcinogen, because it causes increases in kidney tumors in rats, and in liver tumors in mice. There is also suggestive evidence from epidemiological studies that exposure to chloroform and other trihalomethanes is associated with an increased incidence of bladder tumors in humans. Other toxic effects of chloroform include central nervous system depression; eye, skin, and gastrointestinal irritation; and damage to the liver, heart, and kidney.

1,1-DICHLOROETHANE

Dichloroethane (1,1-) is a colorless liquid with a chloroform-like odor. It is used as a solvent and cleaning and degreasing agent as well as in organic synthesis as an intermediate. Exposure to 1,1-dichloroethane may occur through inhalation, ingestion, eye and skin contact. Direct contact to 1,1-dichloroethane may cause skin irritation. Oral exposure to 1,1-dichloroethane has been shown to cause mammary gland, liver and kidney tumors in rats and mice. Therefore, the EPA has classified 1,1-dichloroethane as a Group C possible human carcinogen.

1,2-DICHLOROETHANE

1,2-Dichloroethane (1,2-DCA) is used in synthetics (nylon, rayon, rubber, plastics) industries. It can be used as a solvent, fumigant, and degreaser. It may be used in the photographic, adhesive, water softening, cosmetic, and pharmaceutical industries (Sittig, 1985).

Prolonged dermal contact with 1,2-DCA can cause irritation and dermatitis. Symptoms of inhalation exposure can include CNS effects such as dizziness and depression of respiration, as well as nausea.

EPA has classified 1,2-DCA as a Group B2 probable human carcinogen. 1,2-DCA has also been shown to alkylate DNA.

1,1-DICHLOROETHENE

1,1-Dichloroethene (1,1-DCE), formerly known as vinylidene chloride, is used in the manufacture of 1,1,1-trichloroethane and in polymers. Polymer applications include mortars, concretes, and fabrics (Sittig, 1985).

1,1-DCE is an irritant that can also affect the liver. Inhalation of high concentrations of 1,1-DCE has resulted in CNS depression, as well as liver and kidney damage. 1,1-DCE is highly volatile and is readily absorbed by the respiratory and GI tracts. EPA has classified 1,1-DCE as a Group C possible human carcinogen. 1,1-DCE has been shown to alkylate DNA.

1,2-DICHLOROETHENE

1,2-Dichloroethene (1,2-DCE) is used as a solvent for waxes, resins, and acetylcellulose. It is also used in the rubber extraction, refrigeration, and Pharmaceuticals industry (Sittig, 1985).

1,2-DCE can irritate the skin and mucous membranes. Via the inhalation route, dizziness, nausea, and vomiting and CNS depression may occur (Sittig, 1985). The lungs, liver, and kidneys may be affected.

1,2-DCE is not classified as a carcinogen by EPA.

METHYLENE CHLORIDE (DICHLOROMETHANE)

Methylene chloride, also known as DICHLOROMETHANE, is a volatile solvent and common laboratory contaminant. Like many volatile solvents, methylene chloride can affect the nervous system, especially after inhalation exposure. Potential effects include dizziness, numbness, eye and skin irritation, and cardiac effects.

Methylene chloride is classified by the EPA as a Group B2 (probable human) carcinogen via the oral and inhalation routes of exposure.

APPENDIX A

TETRACHLOROETHENE

Tetrachloroethene (PCE), also known as perchloroethylene, is a commonly used solvent in the dry cleaning, degreasing, and textile industries. It is also used as an intermediate in the manufacture of organic chemicals (Sittig, 1985).

Irritation of the skin can occur after dermal exposure. High-level inhalation exposure can cause respiratory and eye irritation. Other effects include CNS depression and liver damage (Sax, 1989).

EPA ECAO classifies PCE as a Group B2 probable human carcinogen, although this is not considered Agency-wide consensus at this time.

TOLUENE

Toluene is a clear, colorless, noncorrosive liquid with a sweet, pungent, benzenelike odor. Toluene may be encountered in the manufactures of benzene. It is used as a chemical feed for toluene diisocyanate, phenol, benzyl and benzoyl derivatives, benzoic acid, toluene sulfonates, nitrotoluenes, vinyltoluenes, and saccharin. As a solvent, toluene is used for paints and coatings. It is also used as a component of automobile and aviation fuels.

Toluene has been shown to be embryotoxic in experimental animals. Chronic inhalation exposures to high levels of toluene produce central nervous system depression and narcosis in humans. Chronic exposure to toluene at high concentrations by mammals may produce cerebellar degeneration and an irreversible encephalopathy. Co-administration of toluene along with benzene or styrene has been shown to suppress the metabolism of benzene or styrene in rats. In humans toluene may cause irritation to the eyes, respiratory tract, and skin. Acute exposure to toluene causes central nervous system depression, the symptoms of which include headache, dizziness, fatigue, muscular weakness, drowsiness, incoordination with staggering gait, skin paresthesia, collapse, and coma.

1,1,1-TRICHLOROETHANE

1,1,1-Trichloroethane is a colorless, nonflammable liquid with an odor similar to chloroform. In recent years it has been used as a substitute for carbon tetrachloride. In liquid form it is used as a degreaser and for cold cleaning, dip-cleaning, and bucket cleaning of metals.
1,1,1-trichloroethane is a solvent used in dry-cleaning, vapor degreasing, and as a propellant.

APPENDIX A

1,1,1-Trichloroethane is irritating to the eyes on contact with either liquid or vapor phases. This effect is usually first noted in acute exposures. Mild conjunctivitis may develop but recovery is usually rapid. The solvent's defatting properties may produce a dry, scaly dermatitis upon repeated contact with the skin. Acute exposures may lead to dizziness, drowsiness, increased reaction time, incoordination, unconsciousness, and death. Inhalation exposure to high concentrations of 1,1,1-trichloroethane depress the central nervous system; affect cardiovascular function; and damage the lungs, liver, and kidneys in animals and humans. Mucous membranes may also be irritated by exposure to this solvent.

TRICHLOROETHENE

Trichloroethene (TCE) has been used as a solvent in degreasing operations associated with both metal-using industries and dry cleaning. TCE has been used as an intermediate in the production of pesticides, waxes, gums, resins, paints, varnishes, and trichloroacetic acid (Sittig, 1985).

TCE toxicity can include dermatitis, CNS depression, anesthesia, and effects on the liver, kidneys, and heart. TCE is a volatile compound, and inhalation exposure may be significant.

The carcinogenicity of TCE is currently under review.

VINYL CHLORIDE

Vinyl chloride is a volatile organic compound used in the manufacture of polyvinyl chloride and other resins. It is also used as a chemical intermediate and a solvent (Sittig, 1985). Vinyl chloride can be found environmentally as a breakdown product of tetrachloroethene, trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethene.

Vinyl chloride can cause skin irritation and CNS depression. Chronic exposure may cause hepatic damage (Doull, 1986). Vinyl chloride is classified by EPA as a Group A (known) human carcinogen, and has been specifically associated with hemangiosarcoma of the liver.

APPENDIX A

INORGANICS

BARIUM

Barium is an extremely reactive silver white metal produced by the reduction of barium oxide. It may ignite spontaneously in air in the presence of moisture. Barium is insoluble in water but most of the barium compounds are soluble in water. Barium has many uses. It is used for removal of residual gas in vacuum tubes and in metal alloys (e.g., nickel and lead). They are used in the manufacture of lithopone (a white pigment in paints); in synthetic rubber vulcanization; in x-ray diagnostic work; in glassmaking; and in electronics industries. Long-term oral exposure to soluble barium salts may increased blood pressure. Short-term exposure may cause prolonged stimulant action on muscle. Occupation inhalation exposure to barium may result in Baritosis, a non-cancerous lung disease. There are no reports of carcinogenicity associated with exposure to barium.

MANGANESE

Manganese is used in the manufacture of dry cell batteries, paints, dyes, and in the chemical and glass and ceramics industries. Manganese is an essential nutrient in food; the average human intake is reported to be approximately 10 mg/day (Sittig, 1985).

Previous reports of neurotoxicity from manganese were generally reported from high-level occupational exposure to dust and fumes. More recent studies have focused on exposures to drinking water, with subtle neurologic effects being reported after chronic consumption of high concentrations of manganese in water (Sittig, 1985; USEPA, 1993).

Manganese is not classified as a carcinogen by EPA.

APPENDIX A

APPENDIX A-1

TOXICOLOGICAL PROFILES FOR CONTAMINANTS FOR FUTURE CONSIDERATION

ANTIMONY

Antimony is a soft metal insoluble in water and organic solvents. It is widely used in the production of alloys. Short-term oral exposure to antimony has been shown to cause burning stomach pains, colic, nausea and vomiting in humans. Long-term occupational inhalation exposure is associated with heart disease in both humans and laboratory animals. Decreased longetivity and altered cholesterol levels in rats. Antimony has not been tested for carcinogenecity.

ARSENIC

Arsenic has been used by the agricultural, pigment, glass, and metal smelting industries. Arsenic is a ubiquitous metalloid element. Acute ingestion of arsenic can be associated with damage to mucous membranes including irritation, vesicle formation, and sloughing. Arsenic can also be associated with sensory loss in the peripheral nervous system and anemia. Liver injury is characteristic of chronic exposure. Effects of arsenic on the skin can include hyperpigmentation, hyperkeratosis, and skin cancer. (Casarett & Doull, 1986)

EPA classifies arsenic in drinking water as a Group A known oral human carcinogen.

CHROMIUM

Chromium is a heavy metal that generally exists in either a trivalent or hexavalent oxidation state. Hexavalent chromium is soluble and mobile in ground water and surface water. Trivalent chromium is in the reduced form and is generally found absorbed to soil; and therefore, it is less mobile. Hexavalent chromium is used in chrome plating, copper stripping, aluminum anodizing, as a catalyst, in organic synthesis and photography. Exposure to chromium compounds can occur through ingestion, inhalation and skin contact. Hexavalent chromium may have a direct corrosive effect on the skin and may cause upper respiratory tract irritation. Short term exposure to dust or mist of hexavalent chromium may cause upper respiratory distress, headache, fever, and loss of weight. Long term occupational inhalation exposure to dust and fumes of hexavalent chromium has been shown to cause lung cancer in humans, especially those in the chromate-producing industry. In addition, a number of salts of hexavalent chromium are carcinogenic in rats. The EPA has classified hexavalent chromium as a Group A human carcinogen. Trivalent chromium is an essential nutrient and have low toxicity; however, at high levels, it may cause skin irritation.

LEAD

Lead has been used as a gasoline additive (tetraethyl lead) and in paint pigments, batteries, X-ray shielding, and plumbing, and has been associated with smelting and plating industries.

The target organs for lead exposure include the nervous system, hematopoietic system, kidneys, and reproductive system. Symptoms of severe toxicity may include anemia, encephalopathy and peripheral neuropathy. Recently, an association between low-level lead exposure and impaired neurological development in children has been suggested.

EPA considers lead to be a Group B2 probable human carcinogen via the oral route, but no Agency-wide consensus has been reached concerning a cancer slope factor.

MERCURY

Mercury is a silver-white, heavy liquid metal that is slightly volatile at ambient temperatures. Mercury can occur in the environment in either the organic (usually methyl) or inorganic (metallic) form. Mercury compounds are used as preservatives, disinfectants, fungicides, and germicides. Additionally, mercury is used in the plating, dyeing, textile and pharmaceutical industries. In humans, prenatal exposure to methylmercury has been associated with brain damage. Other major target organs for organic mercury compounds in humans are the central and peripheral nervous systems and the kidney. In animals, toxic effects also occur in the liver, heart, gonads, pancreas, and gastrointestinal tract. Experimental studies involving laboratory animals indicate that both organic and inorganic forms of merucry are toxic to embryos.

NICKEL

APPENDIX A

Nickel is a white, hard, ferromagnetic metal that is a naturally-occurring element in the earth's crust and is stable in the atmosphere at ambient temperatures. Nickel forms alloys with a variety of metals, including copper, manganese, zinc, chromium and iron. Elemental nickel is used in electroplating and casting operations, magnetic tapes, surgical and dental instruments, nickel-cadmium batteries, and colored ceramics. Occupational exposure to nickel compounds has been associated with an increased incidence of nasal cavity and lung cancers. For this reason, nickel refinery dust has been classified by the EPA as a Group A - Human Carcinogen via the inhalation route of exposure. The most common reaction to nickel exposure is skin sensitization. Nickel and its compounds also irritate the conjunctiva of the eye and the mucous membranes of the upper respiratory tract.

SILVER

Silver is a white metal insoluble in water and soluble in sulfuric and nitric acids. Alloys of silver (e.g., copper, aluminum, cadmium, lead or antimony) are used in the manufacture of silverware, jewelry, coins, automobiles bearings and grid in storage batteries, in photographic films, in mirrors, as a bactericide for sterilizing water, fruit juices, etc. Some silver compounds are also of medical importance as antiseptics or astringents. Exposure to silver can occur through inhalation of fumes or dust, ingestion of solutions or dust, eye and skin contact. Eye and skin contact with metallic silver may produce local permanent discoloration of the skin similar to tattooing. This process is refer to as argyria. Argyria is characterized by a dark, slate-grey color pigmentation of the skin. Generalized argyria can also develop through exposure to silver oxides or salts through ingestion and inhalation of dust. Silver is not classifiable as to carcinogenicity.

THALLIUM

Thallium is a byproduct of iron, cadmium, and zinc refining. It has been used in alloys, optical lenses, jewelry, semiconductors, and dyes and pigments. Thallium compounds have been used as pesticides. (Casarett and Doull, 1986)

Thallium toxicity can result in hair loss, gastrointestinal irritation, paralysis, nephritis, and liver necrosis. Thallium is one of the more toxic metals, with an estimated lethal dose in humans of 8 to 12 mg/kg. (Casarett and Doull, 1986)

APPENDIX A

ZINC

Zinc is a bluish-white metal that is stable in dry air, but becomes covered with a white coating on exposure to moist air. Zinc is present in abundance in the earth's crust. Zinc chloride is used as a wood preservative, in dry battery cells, in oil refining operations, and in the manufacture of dyes, activated carbon, deodorants and disinfecting solutions. Zinc chromate and zinc oxide are used primarily as pigments. Exposure to zinc compounds can cause skin sensitization, irritation of the nose and throat, fever, and fatigue.

APPENDIX B

EXPLANATION OF EVALUATION CRITERIA

THRESHOLD CRITERIA

Overall Protection of Human Health and Environment is the criteria used to denote whether a remedy provides adequate protection against harmful effects and describes how human health or environmental risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statute and/or provides a basis for invoking a waiver.

PRIMARY BALANCING CRITERIA

Long-Term Effectiveness and Permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment, over time, after cleanup goals have been met.

Reduction of Toxicity, Mobility, and Volume through treatment would be the preferred alternative or remedy. A remedy should have some effect in reducing either the toxicity, mobility, or the volume of waste and thereby reduces the related risks.

Short-Term Effectiveness covers the immediate term in which the remedy can be implemented and the remedy's likelihood of having an adverse effect on human health or the environment during construction and implementation of the remedy.

Implementability includes the technical and administrative feasibility of completing the remedy, covering such items as the availability of materials and services needed to implement the remedy.

APPENDIX B

Cost includes both capital costs and operation and maintenance costs.

MODIFYING CRITERIA

State Acceptance indicates if the state concurs with, disagrees with, or has no comment on the preferred alternative, based on its review of the RI/FS report and the Proposed Plan.

Community Acceptance will be assessed in the Record of Decision following a review and response to the public comments received on the Proposed Plan.